(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 528 542 A3**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : **92306559.3**

(22) Date of filing : **17.07.92**

(51) Int. Cl.[5] : **G02F 1/1347, G02F 1/1335, G02F 1/23**

(30) Priority : **19.07.91 JP 179896/91**
19.07.91 JP 179897/91
19.07.91 JP 179898/91

(43) Date of publication of application :
24.02.93 Bulletin 93/08

(84) Designated Contracting States :
DE FR GB

(88) Date of deferred publication of search report :
04.08.93 Bulletin 93/31

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(54) Optical modulating element and electronic apparatus using it.

(57) A color variable filter for obtaining tranmission light or irradiation light of desired wavelength band electrically in a short time by using liquid crystal, and a novel electronic appliance using such color variable filter. The light entering a color variable filter 1 from one side passes through a liquid crystal element Ci composed of polarizer PLi, liquid crystal panel Pi and polarizer PL(i+1), and the distribution of the transmission light intensity versus the wavelength is nearly a normal distribution centered on a specific wavelength determined on the basis of retardation Δnd of the liquid crystal panel Pi in the liquid crystal element Ci. On the basis of the half-value width W necessary in this distribution, the retardation Δnd of the liquid crystal panel Pi and the number N of the liquid crystal elements Ci are so determined to obtain the band width Rout in the wavelength corresponding to the type of the color of the light desired. The retardation Δnd of the liquid crystal panel Pi is changed, by a voltage regulating circuit 5, so that the transmission light intensity distribution of the liquid crystal element Ci may be maximum at the desired wavelength λO. Therefore, the wavelength of the light leaving the color variable filter 1 may be selected.

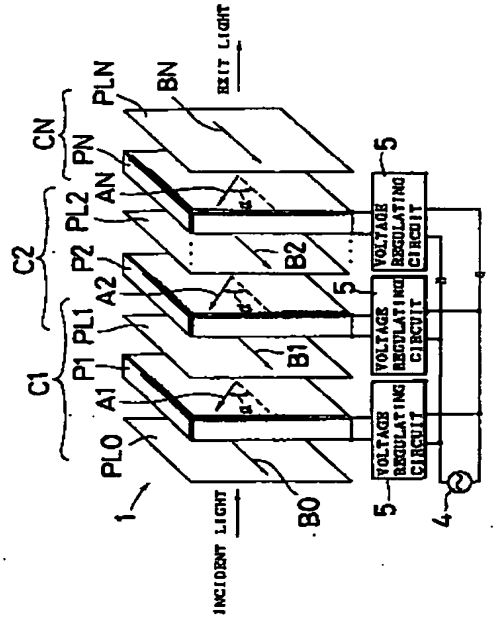

Fig. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 92 30 6559

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	WO-A-8 404 402 (BECKMAN INSTRUMENT) * page 3, paragraph 2 - page 8, paragraph 1 * * page 10, paragraph 2 -paragraph 4 * * page 15, paragraph 2 - page 20, paragraph 1 * * claims 1-9,12-22,24,28; figures 1-3 *	1-11	G02F1/1347 G02F1/1335 G02F1/23
X	PROCEEDINGS OF THE SID. vol. 32, no. 3, 1991, LOS ANGELES US pages 183 - 186 , XP000288381 K. SATO ET AL. 'Novel Multicolor LCD Without a Color Filter' * the whole document *	1-11	
X	ELECTRONICS LETTERS. vol. 11, no. 19, 1975, STEVENAGE GB pages 471 - 472 T. HARRY 'Electrically Tunable Narrowband Optical Filter' * the whole document *	12-23	
X	EP-A-0 138 456 (TEKTRONIX) * abstract * * page 5, line 9 - page 13, line 21 * * page 17, line 28 - page 18, line 21 * * claims 1-4; figures *	24-34	TECHNICAL FIELDS SEARCHED (Int. Cl.5) G02F
X	EP-A-0 052 000 (POLAROID) * abstract; claims *	24-34	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 MAY 1993	IASEVOLI R.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid,

namely claims:

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions.
namely:

see sheet -B-

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid,

namely claims:

☐ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims,

namely claims:

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LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims 1-11 :

   Color tunable filter comprising a plurality of LC elements, each consisting of a pair of polarizers with polarizing axes parallel or perpendicular each other and a birefringent LC panel therebetween, whereby the orientation of the birefringence axis of each LC panel is at an angle determined in advance w.r.t. the polarizing axes of the polarizers and means are provided to change the retardation of each LC panel so that the transmission light distribution is maximum at the desired wavelength(s).
   Use of such color tunable filter in electronic apparata.

2. Claims 12-23 :

   Color tunable filter comprising a plurality of birefringent LC panels and at least a pair of polarizers, whereby the polarizing axes of the polarizer on the outlet side is parallel to the major axis of the generally elliptically polarized light leaving the LC panel in the last stage and means are provided to change the retardation of each LC panel so that the transmission light distribution is maximum at the desired wavelength(s).
   Use of such color tunable filter in electronic apparata

3. Claims 24-34 :

   Color tunable filter comprising a plurality of LC elements, each consisting of color polarizers and a LC panel therebetween, whereby voltage means are provided to switch each LC panel to plural different states so that respective LC elements transmit light at the desired wavelenght(s).
   Use of such color tunable filter in electronic apparata